Committee on Resources

Witness Testimony

Written Statement from
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Presented By
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For the House
Subcommittee on Water and Power Resources
Oversight Field Hearing on
"Issues and Recommendations Concerning the August 10, 1996
Bonneville/Western U.S. Power Outage"
The Honorable John T. Doolittle, Chairman
November 7, 1996

Chairman Doolittle and Members of the Water and Power Resources Subcommittee: thank you for this opportunity to share the perspective of the Los Angeles Department of Water and Power on the Western Interconnection disturbance of August 10, 1996. Like most other utilities in the Southwest, the Department experienced significant impacts of a disturbance originating a thousand miles away. Also like other utilities, the Department is committed to learning whatever we can from this event to maintain and improve the reliability of electric power supply in the Western United States.

EFFECTS IN THE DEPARTMENT'S SYSTEM

The disturbance essentially began at 3:42 PM when the 500,000 volt transmission line between Keeler and Alston sagged into a tree, experienced an electrical flashover, and relayed. The power flowing on this line transferred to other weaker lines in the area, overloading them and causing the voltage in the area to decline. At 3:47 PM, the 230,000 volt Ross-Lexington line sagged into a tree and relayed. At the same time, units at McNary Power House began to trip off. The system became unstable, with growing voltage and power oscillations, and after approximately 75 seconds, oscillations grew to where the voltage on the California-Oregon Intertie lines reached the trip setting of relays protecting those circuits. The 4,300 MW which had been flowing into California from the Northwest instantly over those circuits sought a different path to California, through Idaho, Utah, and Arizona. This surge tripped numerous transmission lines in Arizona, Utah and Southern California, creating three electrical islands. A fourth island was created minutes later due to control actions in the Alberta system.

The power swing resulting from the tripping of the three California-Oregon Intertie lines created severe undervoltage conditions in the Southern California area. Most of the Department's load and transmission facilities survived this undervoltage, with two notable exceptions:

The cooling systems on two solid-state converters on The Pacific High Voltage Direct Current (HVDC) Intertie tripped off due to the low voltage, causing the converters themselves to trip off as well. Additional mercury-arc valve groups may have also tripped off due to the low voltage. As a result, the Pacific HVDC

Intertie, which was carrying nearly 2850 MW from the Pacific Northwest to Southern California, was partially disabled. In the minutes after the disturbance was triggered, the Pacific HVDC Intertie, in its weakened conditioned, became a threat to the security of the Southern California system and was intentionally de-energized at the Department's request.

Pumps at the Hyperion Waste Treatment facility tripped off due to the low voltage, causing partially treated sewage to be dumped into the Santa Monica Bay, forcing the closure of local beaches for a few days after the disturbance.

Eleven generators serving Department load, including units in Utah, Arizona and Southern California, tripped off during the disturbance, mostly due to problems stemming from the power/undervoltage swing. Cut off from the power it had been importing from the Pacific Northwest, the entire southwest island, encompassing Arizona, New Mexico, parts of Baja California, and Southern California, experienced severe underfrequency (58.5 Hz). To stabilize the system and prevent additional loss of load, approximately forty percent of the customers in this region were intentionally and automatically disconnected from the system.

Department load dispatchers used energy from Castaic, a large hydro generating facility north of Los Angeles, to help stabilize the island. Approximately seventy minutes after the disturbance, the frequency had returned to near normal and utilities began to restore customer load. All of the Department's customers were restored to service by 5:30 PM that evening.

ISSUES

The Department actively participated in the Western Systems Coordinating Council's investigation into the disturbance. Additionally, the Department conducted its own in-house investigation into the performance of its system. These investigations brought forth a number of technical and social issues which contributed to the disturbance.

1. INTERCONNECTION-WIDE RESPONSIBILITY FOR RELIABILITY

Competition in the electric power industry promises to do for this industry what telephones, airplanes and even the Internet have done for society at large - effectively shrink the commercial distance between remote parts of the world. In the years ahead, consumers may be purchasing their energy from sources hundreds or thousands of miles away. As the commercial distance between suppliers and consumers on the Interconnected power system shrinks, it will be imperative for all entities deriving economic benefit from the interconnected system to share in the responsibilities for maintaining system reliability. Such steps may include coordinating automatic protective load shedding and restoration, and generator underfrequency or undervoltage protection on an interconnection-wide basis, not just on a local or regional scale. The local or regional practices which have served us well in the past may not be enough to ensure reliability in the competitive future.

2. SHARING TECHNICAL INFORMATION

One of the concerns brought up in the investigation of the August 10 disturbance was whether the Bonneville Power Administration had appropriately made notification of 1) equipment previously out of service for maintenance; 2) three 500,000 volt transmission line outages which occurred in the hours before the disturbance was triggered at 3:42 PM Pacific Advanced Standard Time. While system simulation studies will be necessary to determine the impacts these outages had on the initiation and severity of the

disturbance, the fact that some utilities were not aware of these outages raises questions about the flow of information necessary to preserve reliability. The possibility of problems in one part of the interconnected system impacting other remote parts of the interconnected system, coupled with the additional stress competition may place on operating the existing system, increases the need for sharing technical information in a timely fashion.

3. STUDYING AND MONITORING THE SYSTEM

One of the most important factors in the August 10 disturbance was the failure to identify the severe potential impact of a single 500 kV transmission outage (the Keeler-Alston 500-kV line) and implement operating guidelines to mitigate the impacts of that outage. Similarly, the failure to study, assess the impacts of, and develop mitigating guidelines for the loss of two 345-kV transmission lines out of Jim Bridger contributed directly to the July 2, 1996 Western Interconnection disturbance. Unusually favorable water conditions from a wet winter contributed to unusually high levels of Pacific Northwest hydro generation, which in turn created unusual energy flow patterns in the Pacific Northwest - flow patterns which were considered unlikely. As a result, the system may have been operated in a state which had not been studied.

The onset of competition may also create unusual energy patterns which may not have been previously seen or anticipated. Maintaining the reliability of the power system under changing conditions will require intensifying efforts to accurately model and study the system under a wide variety of conditions. These efforts should include the following:

Voltage collapse. A decade ago, simulation studies primarily focused on transient stability, and the ability of the system to survive the first ten or twenty seconds following the loss of an element. More recently, studies have focused also on voltage collapse, a phenomena which can occur in any time frame from a few seconds to several minutes. Studying and protecting against voltage collapse must become a bigger concern, especially in light of the two Western Connection disturbances of 1996.

Proper modeling of reactive power supplies. The increasing concern over voltage issues has brought forward the need to properly model the reactive power capabilities of generating units. The studies that were done to establish what were believed to be safe operating limits following the July 2 disturbance may have been overly optimistic in modeling the reactive capabilities of generating units, and did not model the uncontrolled loss of McNary units at high levels of reactive output though three McNary units did trip off during the July 2 disturbance.

The North American Electric Reliability Council (NERC) has recommended establishing security centers - regional organizations which will oversee the reliable operations of sections of the interconnected system. Similarly, California has mandated that an Independent System Operator be established to reliably operate the bulk power transmission system. The demand for better, more comprehensive system studies, including, as it becomes more viable, real-time analysis of system security, will probably fall increasingly to these regional security centers.

4. SOCIETAL AND ENVIRONMENTAL IMPACTS ON POWER SYSTEM OPERATION

On August 10, The Dalles, a large hydro generation station in the Pacific Northwest, was operating at reduced capability as part of a program to preserve salmon smolts in the area. This operation reduced the amount of real and reactive power and inertial support available to the Pacific Northwest transmission system, which was operating under stressed conditions at the time.

Such environmentally constrained operations are becoming more commonplace, and are increasing impacting power system operations. For example, even though it contributes a very small portion of the total emissions affecting Southern California air quality, the Department altered the operation of its in-basin units, which provide real and reactive power support to the transmission system serving the City of Los Angeles, to comply with Rule 1135 imposed by the South Coast Air Quality Management District. It is a utility's obligation to comply with the societal and environmental constraints imposed to protect the common good. It is also true that in this energy-dependent society, reliable, economic electric service is also a significant part of the common good, worthy of equal consideration in the public debate.

In summary, Mr. Chairman, the Department believes the major lessons to be learned from this disturbance are:

- the need for old assumptions to be put aside and for all parties deriving benefit from the interconnected system to work together to ensure the continued high degree of system reliability which we have previously enjoyed;
- the need to increase the sharing of technical information even as there is a competition-directed move away from sharing commercial information;
- the need to carefully and completely study a power system which is being operated as never before;
- the need to consider the impacts of constraints imposed on the industry by external concerns.

Thank you again for the opportunity to speak to these issues.

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